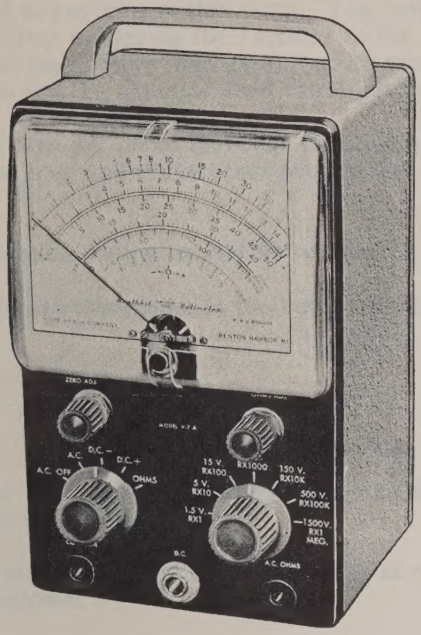
CONSTRUCTION MANUAL NO LONGER AVAILABLE

HEATHKIT VACUUM TUBE VOLTMETER

MODEL V-7A



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SPECIFICATIONS

Electronic D.C. Voltmeter:	
7 Ranges:	0-1.5, 5, 15, 50, 150, 500, 1500 volts full scale, with accessory probe to 30,000 volts
Input Resistance:	11 megohms (1 megohm in probe) on all ranges, 1,100 megohms with accessory probe
Sensitivity:	7,333,333 ohms per volt on 1.5 volt range
Circuit:	Balanced bridge (push-pull) using twin triode
Accuracy:	±3% full scale
Electronic A.C. Voltmeter:	
7 R.M.S. Ranges:	0-1.5, 5, 15, 50, 150, 500, 1500 scales reading R.M.S. (.353 of peak to peak).
Frequency Response (5 v range):	±1 db 42 cps to 7.2 mc (600 Ω source).
Accuracy:	±5% full scale
7 Peak-to-Peak Ranges:	0-4, 14, 40, 140, 400, 1400, 4000
Electronic Ohmmeter:	
7 Ranges:	Scale with 10 ohms center X1, X10, X100, X1000, X10K, X100K, X1MEG. Measures .1 ohm to 1000 megohms with internal battery
Meter:	4 1/2" 200 μA movement, Polystyrene case
Multipliers:	1% precision type
Circuit board:	Printed circuit, etched metal process 3/32" XXP laminated phenolic .00135 copper foil
Tubes:	1 - 12AU7, twin triode meter bridge 1 - 6AL5, twin diode full wave AC rectifier
Battery:	1 1/2 volt flashlight cell
Cabinet Size:	7 3/8" high x 4 11/16" wide x 4 1/8" deep charcoal grey panel, feather grey cabinet
Kit Shipping Weight	7 lbs.
Power Requirements	105-125 volt 50-60 cycle AC 10 watts

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( ) DC TEST LEAD: The DC test lead is made by connecting the phone plug on one end of the shielded test lead, the inner wire conductor to the phone plug tip connection and the wire shield to the phone plug sleeve. On the other end, goes a small 1 megohm resistor which is then slipped inside the black test prod. See Figure 10. It is important that the shield portion of the test lead at the resistor end does not touch the resistor or solder connection. Do not connect the shield to anything at this point. The only shield connection used is made at the phone plug end. After soldering the resistor to the inner conductor of the test lead, do not wrap the joint with tape of any kind as this could cause a high resistance leakage path across the shield portion and the resistor lead resulting in measurement inaccuracies.

( ) AC-OHMS TEST LEAD: The AC ohms test lead is made by connecting the red banana plug on one end of the red test lead and the red test prod on the other. Figure 10 shows the construction.

( ) Fasten the handle on the case, using two 10-24 screws.

( ) Push the rubber feet into the four holes in the bottom of the VTVM case.

TEST AND CALIBRATION

During the preparation of the test leads and cabinet, the VTVM has had an opportunity to warm up thoroughly and should now be calibrated.

Turn the instrument off and make sure that the mechanical zero position of the meter pointer is correct. If not, adjust as follows:

Place the instrument in normal operating position. Turn the black plastic screw on the meter face with a screwdriver while gently tapping the meter face with one finger until the pointer coincides with the zero line on the left side of the scale. Turn the instrument on again.

( ) Set the SELECTOR switch to DC+. Check operation of the zero adjust control. Turning this control should move the meter pointer part way up scale. Set pointer to zero at the left side of the scale and check for zero positioning when the SELECTOR switch is changed to DC-. It should be possible to obtain a zero adjust control position that will permit the meter pointer to remain stationary when switching through from DC+ to DC-. If there is an appreciable zero shift of more than two divisions on the scale, it should be regarded merely as an indication that additional aging of the 12AU7 tube is required. This aging can be obtained by leaving the instrument turned on for a period of 48 hours or more, or through continued use of the VTVM with periodic calibration.

DC CALIBRATE:

Insert the common and DC test leads. Set the SELECTOR switch to DC+ and the RANGE switch to 1.5 volts. Connect the test leads to the calibrated flashlight cell and adjust the DC CALIBRATE control so that the meter pointer falls directly over the very small red dot on the meter face. Approach the red dot going up scale by turning the screwdriver calibrate control and watch the meter read 1.4 volts and 1.5 volts and then the red dot. As soon as the red dot is reached, stop turning the DC CALIBRATE control. Remember that the range switch must be set on 1.5 volts for this adjustment.

OHMS CHECK:

Turn off VTVM. To install the battery, start top (+) end of the battery into the battery cup and then pull the spring out and over the bottom (-) end of the battery. Now push the spring and the battery in under the metal brace so the spring, battery and battery cup are all in line. Turn on VTVM and set SELECTOR switch to OHMS. Set OHMS ADJUST for full scale (infinity). Insert AC-OHMS test lead and touch probe to common test clip. Meter pointer should drop to zero at left end of scale (no resistance).

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AC CALIBRATE:

Temporarily remove AC OHMS test lead. Set RANGE switch to 1.5 volts and SELECTOR switch to AC. Adjust AC BALANCE control so no movement is noticed in the pointer when switching from AC through DC- to DC+. Now set RANGE switch to 150 volts and the SELECTOR switch to AC. Reinsert AC ohms lead. Connect AC ohms and common lead to the 117 volt AC line.

WARNING: 117 volt AC line is dangerous. Proceed with due care.

Adjust AC CALIBRATE control until pointer indicates the line voltage (117 volts AC).

AGING

It is recommended that the tubes be aged before final calibration. This is accomplished by keeping the instrument turned on for a period of at least 48 hours. Final calibration should be done in the same way as the initial calibration. Careful calibration will result in a more accurate instrument. If a standard AC meter is available, it is desirable to use such an instrument preferably at a voltage near full scale on the VTVM as for instance, 140 volts or 40 volts on the 150 volt or 50 volt range respectively.

One of the major advantages of kit form instrument construction is that the kit builder becomes thoroughly familiarized with calibration procedure and is therefore in an excellent position to periodically check VTVM operating accuracy instead of assuming that usual factory instrument calibration is still valid.

Please bear in mind that any fresh stock flashlight battery will actually measure 1.55 volts and can be used for calibrating purposes. The battery supplied with your VTVM was individually checked for proper voltage and marked accordingly as a precautionary measure. It is evident that it will not be necessary for the kit purchaser to obtain a specially calibrated battery from the Heath Company when battery replacement is required. Any standard brand fresh stock battery will serve the purpose.

After final calibration, place the instrument in the cabinet and install the two #6 sheet metal screws through the back and into the bracket. The instrument is now ready for use. The power consumption of the VTVM is very low and there is no objection to leaving the instrument on continuously during the daily work period rather than turning it off each time a measurement function is completed. Daily operation for a period of several hours or more will also serve the purpose of eliminating possible moisture accumulation.

IN CASE OF DIFFICULTY

In event the instrument does not perform properly and calibration procedure cannot be obtained in the manner described, we would suggest that you observe the following check procedure.

1. Recheck all wiring to the RANGE and SELECTOR switches and make sure that all connections are properly made. Most cases of trouble result from improper or reversed connections. Often having a friend check the wiring will reveal a mistake that is consistently overlooked.

2. Check the 6AL5 and 12AU7 tubes. If possible, check tube performance in the VTVM circuit by substitution with tubes known to be in good operating condition. Tubes used in this VTVM do not require special selection and their replacement should not present a problem.

3. If the meter pointer swings full scale to the right and stays there with SELECTOR switch at DC+, check for an open circuit or high resistance connection somewhere between the grid pin 2 of the 12AU7 tube and ground. This condition might be due to a wrong connection to the SELECTOR switch, a poor connection or possibly an open resistor.

If the instrument does not operate on any function, a check of the power supply, the 12AU7 tube and its associated meter circuit is suggested.

If the instrument fails to function on AC measurements only, then a check of the 6AL5 and its associated circuits should be made.

If the instrument only fails to function on ohms, the difficulty will probably be due to the battery (make certain the battery is making good contact in the bracket) or the ohms multiplier resistor string. If the resistor string is open at some point, the meter pointer will usually deflect to the extreme right of the meter scale, regardless of the setting of the ohms adjust control.

It is important that proper operation on DC+ or DC- should first be obtained before any attempt is made to use the instrument on AC or ohms.

4. Check the operating voltages. The following voltages are measured to chassis. Pins 1 or 6 of the 12AU7 tube or positive lug on the rectifier, 50-70 volts positive. Negative side of filter condenser, 60-85 volts negative.

5. Check continuity through the DC test cable. Make certain that the shielding is not shorted to the center conductor or that the 1 megohm isolating resistor inside the test prod is not being grounded.

6. Insufficient range of zero adjust control could indicate that possibly the wire jumper between pins 1 and 6 of the 12AU7 tube has been omitted.

7. Visually inspect all construction to determine the possibility of wire cuttings or blobs of solder being lodged against control terminals, switch contacts, etc.

NOTE: If circuit board is accidentally damaged by dropping, resulting in cracks in the laminate, the following precautions should be observed. A break in the board will almost always cause a corresponding break in the foil pattern. In event this should occur, the foil pattern can be easily repaired by bridging the foil break with a short length of bare wire. Just lay the wire right on the pattern, bend to fit foil contours if necessary, and then solder the full length of the wire.

Alternately flexing each corner of the board slightly while the instrument is in operation will usually reveal whether or not a foil pattern break is present as the instrument will react in an erratic manner.

The circuit board used in your VTVM is rugged and serviceable and under normal conditions of usage, the board does not require unusual handling precautions. However, the information supplied will be helpful in the event an accident should occur.

SERVICE

If, after applying the information contained in this manual and your best efforts, you are still unable to obtain proper performance, it is suggested that you take advantage of the technical facilities which the Heath Company makes available to its customers.

The Technical Consultation Department is maintained for your benefit. This service is available to you at no charge. Its primary purpose is to provide assistance for those who encounter difficulty in the construction, operation or maintenance of HEATHKIT® equipment. It is not intended, and is not equipped to function as a general source of technical information involving kit modifications nor anything other than the normal and specified performance of HEATHKIT® equipment.

Although the Technical Consultants are familiar with all details of this kit, the effectiveness of their advice will depend entirely upon the amount and the accuracy of the information furnished by you. In a sense, YOU MUST QUALIFY for GOOD technical advice by helping the consultants to help you. Please use this outline:

1. Before writing, fully investigate each of the hints and suggestions listed in this manual under "IN CASE OF DIFFICULTY." Pos-

PARTS LIST

PART No.	PARTS Per Kit	DESCRIPTION
Resistors		
2-48	1	9.1 Ω carbon
1-3	1	100 Ω carbon
1-20	1	10 KΩ carbon
1-23	1	27 KΩ carbon
1-27	2	150 KΩ carbon
1-29	1	220 KΩ carbon
1-35	1	1 megohm carbon
1-38	1	3.3 megohm carbon
1-40	1	10 megohm carbon
1-70	5	22 megohm carbon
2-24	1	90 Ω precision
2-29	1	900 Ω precision
2-35	1	9 KΩ precision
2-50	1	10 KΩ precision
2-38	1	20 KΩ precision
2-9	1	70 KΩ precision
2-41	1	90 KΩ precision
2-86	1	150 KΩ precision
2-54	1	200 KΩ precision
2-87	1	320 KΩ precision
2-13	1	700 KΩ precision
2-51	1	900 KΩ precision
2-55	1	2 megohm precision
2-16	1	7 megohm precision
2-52	1	9 megohm precision
2-28A	1	900 KΩ 1 watt precision
Condensers		
21-27	2	.005 400 v. disc ceramic
21-31	2	.02 400 v. disc ceramic
23-60	1	.01 1600 volt tubular
25-5	1	16 μfd 150 v.
Controls-Switches		
10-8	2	10 KΩ control
10-38	3	10 KΩ control
63-79	1	RANGE switch
63-80	1	SELECTOR switch
Tubes-Lamps		
411-25	1	12AU7 tube
411-40	1	6AL5 tube
412-4	1	#50 pilot lamp
Sockets-Knobs-Feet		
434-112	1	7-pin socket
434-79	1	9-pin socket
434-47	1	Pilot light socket
462-19	2	Skirt knobs
462-30	2	Knobs, small
261-1	4	Rubber feet

PART No.	PARTS Per Kit	DESCRIPTION
Wire-Grommets		
89-1	1	Line cord
340-2	1	length Bare wire
341-1	1	length Black test lead
341-2	1	length Red test lead
343-3	1	length Shielded test lead
344-1	1	roll Hookup wire
346-1	1	length Spaghetti (sleeving)
346-6	1	length 3/8" fiberglas sleeving
347-1	1	length 8-wire cable
73-1	1	3/8 rubber grommet
Sheet Metal Parts		
90-17	1	Cabinet and rear cover
203-61F258	1	Front panel
204-M69	1	Bracket assembly
214-2	1	Battery housing cup
204-M84	1	Z support bracket
Hardware		
250-8	2	#6 x 3/8 sheet metal screw
250-9	3	6-32 x 3/8 screw
250-83	2	#10 x 1/2" handle screw
250-31	1	6-32 x 1/4 screw
252-3	4	6-32 nut
252-7	5	Control nut
252-9	2	Speednut, jack
253-2	1	#6 fiber shoulder washer
253-10	5	Control nickel washer
254-1	4	Lockwasher
254-4	5	Control lockwasher
253-3	2	#10 flat fiber washer
Miscellaneous		
54-23	1	Power transformer
57-13	1	Selenium rectifier
70-5	1	Banana plug insulator, black
70-6	1	Banana plug insulator, red
85-9F102	1	Circuit board, complete
211-4	1	Handle
258-7	1	Spring, phosphor bronze
260-1	1	Alligator clip
407-62	1	200 microamp meter
418-1	1	Flashlight cell
436-1	1	Phone jack
436-2	1	Banana jack, black
436-3	1	Banana jack, red
437-1	2	Banana jack insert
438-3	1	Phone plug
438-13	2	Banana plug assembly
439-1	1	Red test prod
439-2	1	Black test prod
595-110	1	Manual

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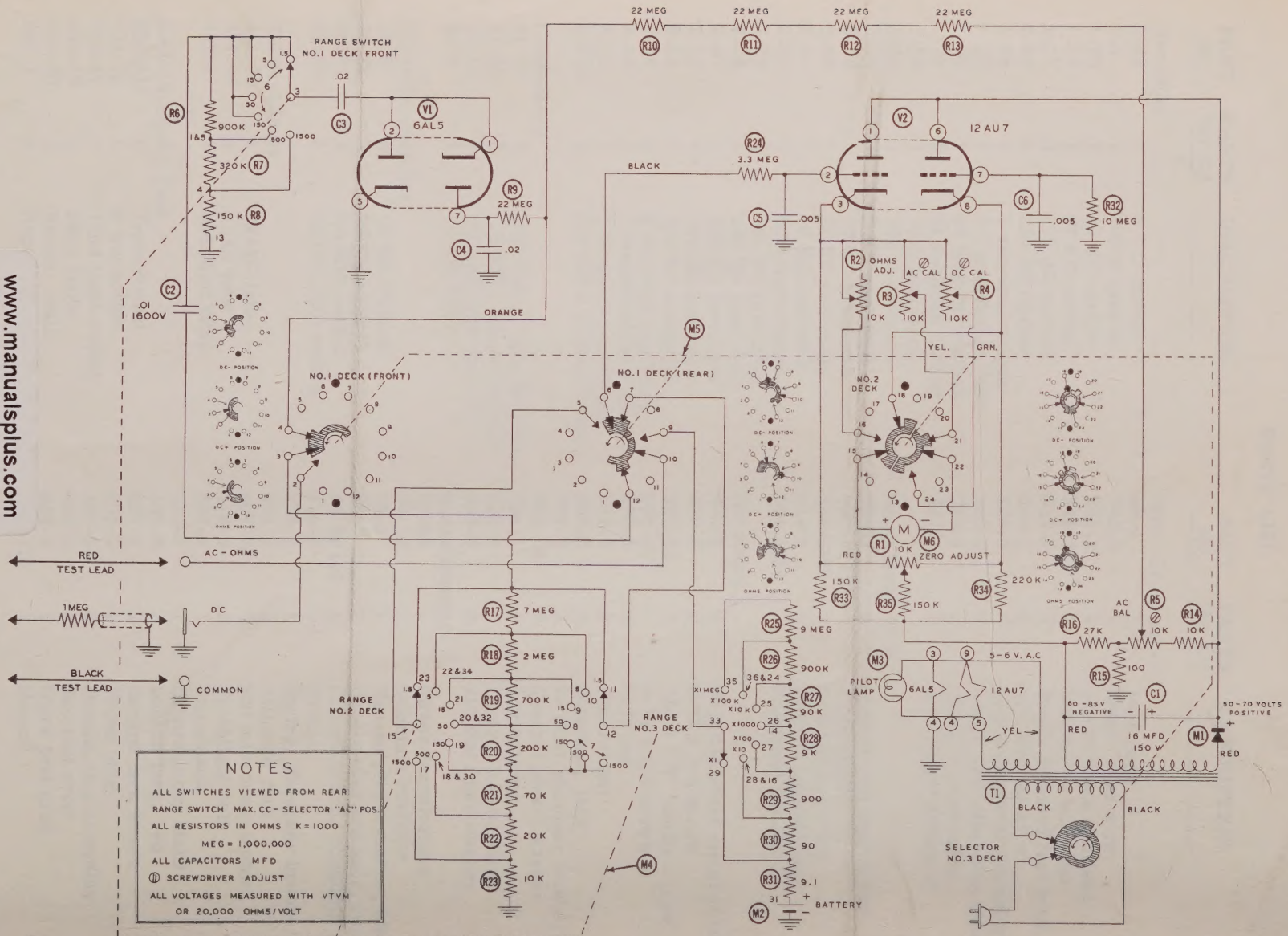

HEATHKIT PEAK-TO-PEAK VTVM
MODEL V-7A